



NOAA RISA

2012 annual report

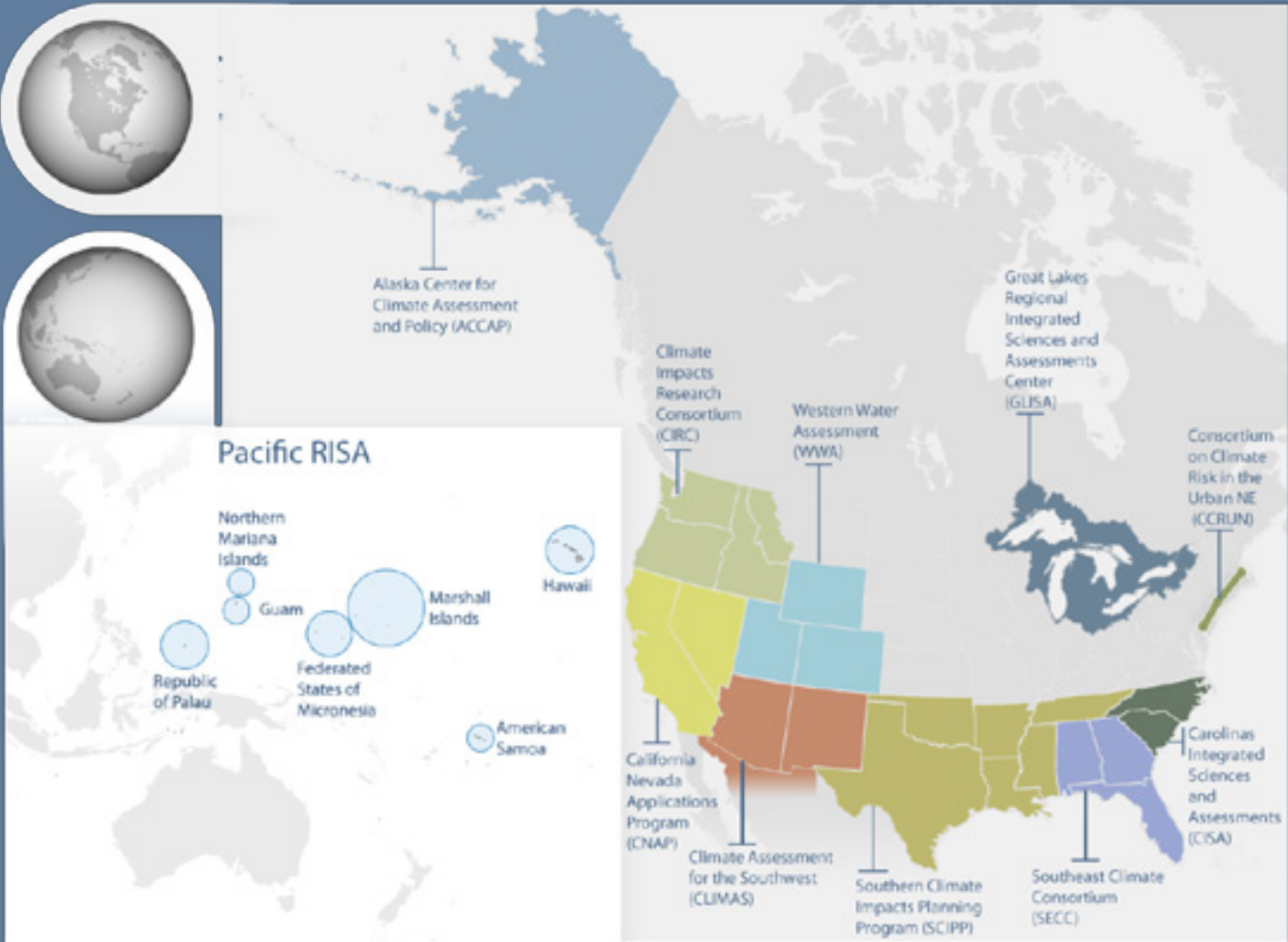
www.cpo.noaa.gov/cpo_pa/risa | www.noaa.gov | www.commerce.gov

For over 15 years, NOAA's Regional Integrated Sciences and Assessments (RISA) program has been supporting research teams that conduct interdisciplinary and regionally relevant research to inform resource management, planning and public policy. RISA teams help build the nation's capacity to prepare for and adapt to climate variability and change by providing cutting-edge scientific information to public and private user communities. NOAA currently supports 11 RISA teams through five-year, cooperative agreement awards.

This report describes some of the major activities and accomplishments of the RISAs in 2012. Chapter 1 introduces each RISA in 140 characters or less and showcases some of their achievements as well as new areas of research teams have started exploring in 2012. In addition, it contains RISA websites and social media accounts for readers wanting to know more about their research. Chapter 2 illustrates how the RISA teams are contributing to research on and response to extreme climate and weather events in their region including a number of the extremes seen in 2012 from sea ice to Sandy.

CHAPTER 1:

RISA Major Highlights & Emerging Research



Geographical extent of the RISA teams.



Left: Stakeholders from the Big Wood River Basin in Idaho working on a whiteboard at a workshop organized by CIRC researchers. CIRC **Middle:** Myron Johnson (left), a row crop farmer from Alabama, talks with SECC researcher Wendy-Lin Bartels (right) about how he uses climate information to help in planning his planting season. Brian Kahn/IRI **Right:** ACCAP researcher Phil Loring working on a fisheries project in Alaska. ACCAP

ALASKA CENTER FOR CLIMATE ASSESSMENT AND POLICY

Top: University of Alaska graduate student Hannah Harrison with a 45 lb. king salmon. **ACCAP Bottom:** ACCAP researcher Phil Loring doing work on Alaska's coast. **ACCAP Background:** Coastline in southeast Alaska. NOAA



ACCAP IN 140 OR LESS...

Improving the ability of Alaskans to respond to a changing climate.

2012 HIGHLIGHT

Commercial fishing provides over \$5.8 billion in direct and indirect economic benefits to Alaska. At the same time, noncommercial fishing activities are of utmost importance to communities across the state from rural areas on the coast and inland to the urban hubs of Fairbanks and Anchorage by providing food and shared traditions. A changing climate and associated changing ecosystems and salmon populations may reduce community stability while increasing vulnerability. In response, ACCAP researcher Philip Loring conducted a study on food security in the Kenai Peninsula with partners at the Kachemak Bay Research Reserve and Sustainable Homer. The ability to fish locally is an important source of food security for low-income households of the Kenai Peninsula and suggests a related vulnerability if fisheries decline. Local opinion and perspectives on the Kenai Peninsula are heavily divided regarding the sustainability of local salmon populations, which feeds into a general distrust of management and contentious relationships between commercial, sport, personal use and subsistence fishing sectors. The reputation for sustainability in Alaska fisheries may be counteracting opportunities for meaningful social change and improvement of quality of life in rural Alaska, as well as continued improvement in the management of Alaska fisheries. The associated outcome is that fishing-dependent coastal communities remain vulnerable to the challenges of climate change despite an apparently thriving commercial industry.

NEW RESEARCH IN 2012

- ACCAP initiated an ocean acidification sensitivity index for coastal Alaska to analyze the impacts of acidification on Alaskan waters and coastal communities. ACCAP is working with coastal communities to help them better understand and adapt to the resulting ecological and economic implications.
- ACCAP partnered with the Tongass National Forest, Alaska Coastal Rainforest Center and Scenarios Network for Alaska and Arctic Planning to analyze exposure and sensitivity of resources to climate-related changes in and around the Tongass National Forest using the best performing climate models and associated scenarios for southeast Alaska.

CONNECT

www.accap.uaf.edu

[www.twitter.com/SNAPandACCAP](https://twitter.com/SNAPandACCAP)

www.facebook.com/snapandaccap

www.youtube.com/user/SNAPandACCAP

CALIFORNIA NEVADA APPLICATIONS PROGRAM

Foreground: CNAP researcher Nina Oakley visiting an elementary school in Reno, Nevada and discussing how climate is monitored using a deployable RAWS station. **Background:** Point Reyes National Seashore. Brian Kahn/IRI



CNAP IN 140 OR LESS...

Developing climate information for and about stakeholders, mainly in water resources, wildfire, and coastal sectors.

2012 HIGHLIGHT

The diverse topography and economy across California and Nevada requires the region to deal with a variety of climate and weather extremes from coastal flooding to wildfires to severe snowstorms to drought. The California Climate Extremes Workshop brought together diverse experts from the physical, biological, social, and economic sciences and nearly 150 stakeholders and decision makers from government agencies, community groups, schools, industries, and the general public. The workshop provided scientific information on evolving weather and climate extremes covering a range of topics that included heat waves, water supply, sea level and coastal flooding, reservoir management, agricultural and ecological impacts, wildfires, human health, and economic implications.

The resulting report was distributed to decision-makers, scientists, and stakeholders, including attendees of the Association of Pacific Rim Universities Coastal Cities and Sea Level Rise workshop and the California Energy Commission's Integrated Energy Policy Report workshop on climate forecasts and change for energy applications. Video of the original workshop is also available [online](#).

NEW RESEARCH IN 2012

- CNAP is...
 - Assessing possible wildfire changes under future climate in California and Nevada.
 - Developing, evaluating, and distributing drought early warning information.
 - Analyzing the future of atmospheric rivers that can bring strong storms to the West Coast.
 - Understanding marine stratus cloud variability and that variability's impact on California temperature.

CONNECT

www.meteora.ucsd.edu/cnap

CAROLINAS INTEGRATED SCIENCES AND ASSESSMENTS

Top: Managed impoundment along Cooper River, SC. Dan Tufford/CISA
Bottom: Greg Carbone leading discussion at a stakeholder workshop. Ashley Brosius/CISA
Background: View of Beaufort, SC and the Beaufort River from Lady's Island, SC. Kirsten Lackstrom/CISA

CISA IN 140 OR LESS...

Working with decision makers across the Carolinas to incorporate climate science into water and coastal management and support adaptation.

2012 HIGHLIGHT

Understanding vulnerability is crucial to coastal communities' ability to be resilient in the face of climate change. The South Carolina Sea Grant Consortium, Social and Environmental Research Institute, and CISA have developed the Vulnerability and Consequence Adaptation Planning (VCAPS) process, which integrates local and scientific knowledge and facilitates structured and efficient dialogue about the consequences of climate change impacts.

CISA and its partners jointly implemented **VCAPS projects** in Sullivan's Island and McClellanville, SC and Plymouth, NC in 2010-11. Since 2011, the VCAPS process has also been conducted beyond the Carolinas, with projects in coastal communities in the Gulf Coast and New England. These and future VCAPS projects in Beaufort, SC and Columbia, NC have or will provide tailored, decision-relevant information to coastal communities on the implications of climate variability and change and adaptation strategies that increase resilience to those impacts. In addition to these projects, CISA and its partners have offered VCAPS training sessions to outreach personnel in Sea Grant, the National Estuarine Research Reserve System Coastal Training Program, cooperative extension offices, and others.

NEW RESEARCH IN 2012

- To investigate the links between climate and heat stress, CISA researchers are examining region- and population-specific vulnerabilities, assessing methods to improve existing warning systems, and developing tools that will translate current and predicted weather-climate conditions into probabilities of heat-related emergencies.
- In order to meet stakeholder needs for climate scenarios in water-use planning, researchers are integrating statistical and dynamical downscaling with hydrological models at the watershed scale. Watersheds models are being developed to assess water quality under future climatic and land use scenarios as an additional tool in water-use management and planning.

CONNECT

cisa.sc.edu

CLIMATE ASSESSMENT FOR THE SOUTHWEST

Top: A farmer in the Rio Grande Valley. Zack Guido/CLIMAS
Bottom: Elephant Butte Reservoir near Truth or Consequences, New Mexico. The reservoir was at 6 percent capacity as of December 2012 and agricultural outflows are extremely limited. Zack Guido/CLIMAS
Background: The Grand Canyon in winter. Brian Kahn/IRI

CLIMAS IN 140 OR LESS...

Interdisciplinary research to improve the Southwest's resiliency to changes in weather and climate extremes.

2012 HIGHLIGHT

What will Tucson's climate look like in 2050 and what does it mean for city planners today? Co-Principal Investigator Gregg Garfin worked with City of Tucson and Pima County managers, the City's Climate Change Committee, Cascadia Consulting, and Adaptation International to find out. Garfin and the team took user-defined extreme climate change thresholds and developed downscaled climate projections for the Tucson metro area. In a nutshell, the team found that by midcentury, Tucson's consecutive days with extreme high temperatures above 110°F are projected to increase by a month while it's extreme heat season will expand by weeks. On the other side of the coin, days with temperatures below freezing will decrease. Finally, the number of consecutive days without precipitation will increase by one week. These findings have broad applications in professional communities as diverse as public health, construction, recreation and water management. Tucson's Mayor and City Council have been briefed on the findings. They have also informed the Climate Change Committee and contributed to a broader public awareness of climate change in the region. A report to the City and a peer-reviewed publication are also forthcoming.

NEW RESEARCH IN 2012

- Researchers are developing climate services that improve the Federal Emergency Management Agency's disaster management in the region.
- CLIMAS is using a participatory approach to develop a consensus-based program theory and logic model, and to formulate a set of metrics that measure the program's short-, medium-, and long-term outcomes.
- GIS visualization of flood risk, extreme heat risk, and social vulnerability with maps are being used to inform adaptation planning decisions.

CONNECT

climas.arizona.edu

www.southwestclimatechange.org/

www.facebook.com/pages/Southwest-Climate-Change-Network/113859637865

CLIMATE IMPACTS RESEARCH CONSORTIUM

Top: Mount Rainier. Josh Foster/CIRC **Bottom:** Stakeholders and CIRC researchers at the Big Wood River Basin workshop. CIRC **Background:** Broken Top Mountain and wildflowers near Bend, Oregon. Brian Kahn/IRI

CIRC IN 140 OR LESS...

Supporting Northwest climate adaptation by building knowledge-to-action networks to improve resilience to climate variability and change.

2012 HIGHLIGHT

Anglers, farmers, community members, and water managers all have a strong stake in the Big Wood River Basin in Idaho. To ensure sustainable and fair management into the future, CIRC's Regional Extension Climate Specialist John Stevenson has worked with stakeholders to set up a knowledge-to-action network around changes to hydrological processes in the basin. The process started with a workshop for stakeholders in the basin hosted by Stevenson and CIRC Principal Investigator Denise Lach. Stakeholders in attendance included the Bureau of Reclamation, Idaho Department of Natural Resources, local farmers and water managers, and others. Over the course of the workshop, stakeholders identified hydrological research priorities in the basin and possible planning tools, and committed to participating in the network that connects regional climate change information with local, concrete actions.

Since the workshop, Stevenson has helped the network set milestones for refining research questions, studying different problem-solving approaches and creating a timetable for researchers to deliver tools and services for climate adaptation priorities. CIRC researchers John Bolte, V. Sridhar, and grad student Allison Marshal have also developed the first version of a systems dynamics model connecting various environmental changes with management decisions.

NEW RESEARCH IN 2012

- CIRC is creating a coordinated set of climate scenarios from CMIP5 global climate models for the Pacific Northwest and Western U.S., including integrated climate, hydrological, and vegetation models.
- Researchers are building coastal 'Knowledge to Action Networks' consisting of collaborative teams of stakeholders, researchers, and outreach specialists who will co-produce knowledge to inform climate resilient strategies in select Pacific Northwest coastal counties. Objectives include developing integrated methodology for projecting the probability of coastal flooding and erosion through time along the PNW coast, assessing impacts including community and ecosystem vulnerabilities, developing future scenarios, and initiating adaptation strategies related to sea level rise and changing storminess.

CONNECT

www.pnwclimate.org

CONSORTIUM FOR CLIMATE RISK IN THE URBAN NORTHEAST

Foreground: A CCRUN researcher hangs a miniature pollen trap on a New York light pole as part of the New York City Community Air Survey Network, a new project on climate change, pollen and allergic diseases. Pat Kinney/CCRUN **Background:** Manhattan's Financial District as seen from Governor's Island. Brian Kahn/IRI

CCRUN IN 140 OR LESS...

Helping the urban Northeast find ways to be resilient to climate change, no matter what Mother Nature throws at us.

2012 HIGHLIGHT

Coastal storms are among the world's most costly disasters. Strong winds, floodwater inundation and coastal erosion from them often damage critical infrastructure and disrupt livelihoods. Storm surge modeling is an important tool for flood forecasting and hazard assessments, particularly when it comes to understanding risks from moderate to severe storms that have occurred locally only a few times, if any, in the historical record. With input from stakeholders at federal, state, and local governments and the private sector, CCRUN has refined an already highly detailed coastal ocean model by incorporating freshwater flows and water density variations. These updates have corrected a bias toward low storm surge estimates often found in other more simplified surge models. This improved model, together with data from the New York Harbor Observing and Prediction System, has been demonstrated to provide highly accurate storm surge predictions for the **Center for Maritime Systems Storm Surge Warning System**. Next steps for CCRUN involve linking the storm surge model to next-generation sea level rise projections created by CCRUN for New York City's government and other urban stakeholders throughout the Northeast.

NEW RESEARCH IN 2012

- Under an array of future warming scenarios, heat-related deaths become more common outside of the summer months, but are not purely an urban phenomenon – heat poses a significant risk in rural as well as urban areas. CCRUN researchers are looking at some of these non-urban risks and vulnerabilities in the region.
- CCRUN researchers are doing a comparative study of coastal zones in New York City and Boston. Working with local stakeholders, researchers are collaborating to develop adaptation blueprints that specify decision and implementation processes for well-defined types of neighborhoods, informed by dynamic maps that represent several dimensions of vulnerability.

CONNECT

www.ccrun.org

GREAT LAKES INTEGRATED SCIENCES AND ASSESSMENTS CENTER



Top: GLISA and its advisory committee members meet with representatives of boundary organizations funded by GLISA. Rebecca Guerriero/GLISA **Bottom:** Doctoral candidate Abigail Lynch holding a whitefish. Her work developing a tool to manage the impacts of climate change on whitefish is supported by GLISA. Amanda Handziak/Chippewa Ottawa Resource Authority **Background:** Satellite image of the Great Lakes in winter. NASA Earth Observatory

GLISA IN 140 OR LESS...

Collaborative research that connects the producers and users of climate information to improve decisions in the Great Lakes Basin.

2012 HIGHLIGHT

GLISA is co-coordinating the Midwest Region Technical Input Team for the National Climate Assessment. The team brings together sectoral experts from academia, nongovernmental organizations, and federal agencies. Ahead of the full Assessment in 2013, GLISA's efforts have resulted in a series of eleven reports that capture the state of knowledge regarding climate change and variability throughout the region. **These reports** have been posted online and are an invaluable resource to decision makers and researchers in the region. So far they have been accessed more than 1800 times and will inform the broader assessment set to be released in 2013.

NEW RESEARCH IN 2012

- Pursuing advice GLISA received from its advisory committees, in 2012 GLISA focused its climate assessments grant competition on reaching boundary organizations that work directly with decision makers in the Great Lakes region. GLISA funded **projects from six organizations** in Michigan, Ontario, and Illinois and will be working closely with them over the next year to provide climate information and learn lessons about best practices.
- Working closely with stakeholders, GLISA developed a format for **station** and **divisional** climatologies. These resources, available online have been well received as a communications tool for stakeholders and decision makers.

CONNECT

www.glisa.msu.edu
www.facebook.com/greatlakesclimate

PACIFIC RISA



Left: Pacific RISA researcher Richard Wallsgrove leads a workshop for water resource managers on Maui in July 2012. The findings are presented in a 2012 white paper. Pacific RISA **Right:** Pacific RISA Principal Investigator Melissa Finucane speaks with Ka'u District rancher Michelle Galimba while filming the "Climate Matters for Ranchers in Hawaii" Document. Victoria Keener/Pacific RISA **Background:** Palm trees on Kauai. Brian Kahn/IRI

PACIFIC RISA IN 140 OR LESS...

An interdisciplinary research program that supports Pacific Island communities in adapting to climate variability and change.

2012 HIGHLIGHT

Pacific RISA researchers, closely collaborating with partners in the region, coordinated a comprehensive assessment of the current state of knowledge about climate change impacts on the Hawaiian archipelago and U.S.-affiliated Pacific Islands and adaptive capacity in the region. The report, **Climate Change and Pacific Islands: Indicators and Impacts**, highlights the findings of more than 100 experts comprising the Pacific Islands Regional Climate Assessment (PIRCA). To provide the foundation for the assessment, Pacific RISA convened scientists, local resource managers, and other experts in a series of technical workshops. Participants discussed climate knowledge in three focus areas: (1) preserving fresh water resources and minimizing impacts of drought; (2) fostering community resilience to the impacts of sea level rise, coastal inundation, and extreme weather; and (3) sustaining aquatic and terrestrial ecosystems. In addition to co-facilitating the assessment Pacific RISA's principal investigator Melissa Finucane and program manager Victoria Keener contributed substantial research time. **Eight case studies** exploring examples of both climate change impacts and adaptation in the Pacific were also developed for the assessment. The report and case studies will inform the National Climate Assessment due out in 2013. PIRCA is also generating subsidiary publications and products from the report and the release of these will continue throughout 2013.

NEW RESEARCH IN 2012

- In collaboration with the USGS Pacific Islands Water Science Center, Pacific RISA researchers are examining the general effects of seasonal climate variability on historic streamflow and precipitation at sites throughout Hawaii, American Samoa, and Guam.
- Using the release of PIRCA as a springboard, Pacific RISA will study communication patterns and how climate information spreads across different sectors and countries in the Pacific Islands region. This analysis will allow Pacific RISA and other groups to focus research and resources on areas that may have been previously ignored.

CONNECT

www.pacificrisa.org
www.vimeo.com/pacificrisa
www.flickr.com/photos/pacificrisa

SOUTHEAST CLIMATE CONSORTIUM

Top: SECC members Dick McSnider and John Christy (to left of Governor Bentley) at the Alabama irrigation bill signing. **SECC Bottom:** Calvin Perry, superintendent of the Stirling Research Park speaks to farmers, researchers and extension agents at the SECC Row Crop Agriculture Working Group. **SECC Background:** The Tampa Bay coast. Brian Kahn/IRI

SECC IN 140 OR LESS...

A team of climate, biological, and social scientists offering practical solutions for managing climate risks at locally and regionally.

2012 HIGHLIGHT

The corn crop in Alabama has traditionally been grown without irrigation. Yields fluctuate widely from year to year soils have poor water holding capacity, which leads to frequent short-term droughts that make Alabama grown corn non-competitive with the Midwest with its deep water holding soils. SECC researchers John Christy, Dick McNider, Cameron Handyside, and Gerrit Hoogenboom used historical climate data with crop simulation models to show that irrigation would generally double average yields and nearly stabilize corn yields. The researchers showed further that by storing winter rainfall in ponds using both direct capture from rainfall and pumping from streams to fill ponds, farmers could achieve the benefits of irrigation for the spring corn crop and pay for the costs of the pond and irrigation apparatus within 4-7 years. Moreover, by capturing winter rains when streams are usually at their highest levels, there are few or no adverse ecological impacts. A 2008 Farm Bill Program initiated by the SECC and introduced by Senator Jeff Sessions (R-AL) and Congressman Terry Everett (R-AL) provided money to build about 35 such ponds in Alabama. One of the farmers that participated in the reservoir project said, "When I see that water flowing into the reservoir, I see money flowing into my bank account." The results were so compelling that the Alabama legislature enacted a bill to provide a 20 percent tax credit for the purchase and installation of irrigation systems and construction of reservoirs in June 2012.

NEW RESEARCH IN 2012

- Using daily meteorological data from satellites, Doppler radar, and automatic weather stations as inputs to a corn crop simulation model, SECC researchers in Alabama and Georgia have developed a **system to monitoring corn crop status** in the Southeast at a 4-kilometer resolution.
- Researchers at Florida State have developed a series of datasets specific to the Southeast for use by SECC researchers and interested parties. **The datasets** include regional reanalysis at a 10-kilometer resolution (1979-2000 and 1901-2008); regional climate change ensemble at a 10-kilometer resolution; and seasonal hindcasts using a regional spectral model (1982-2008).

CONNECT

www.seclimate.org

www.facebook.com/southeastclimateconsortium

SOUTHERN CLIMATE IMPACTS PLANNING PROGRAM

Foreground: Flooding in Lake Charles, LA. Hal Needham/SCIPP **Background:** A cargo ship navigates the Mississippi River near New Orleans, Louisiana. Brian Kahn/IRI

SCIPP IN 140 OR LESS...

To increase resiliency and preparedness for weather and climate extremes now and in the future across OK, TX, AR, LA, TN, and MS.

2012 HIGHLIGHT

The Saffir-Simpson Hurricane Scale measures hurricane wind strength. However, it reveals very little about storm surge, which can be equally if not more devastating. SCIPP researchers Barry Keim and Hal Needham have created SURGEDAT, the world's most comprehensive archive of storm surge data, to provide more context on storm surges. Utilizing 67 sources of data including federal government sources, books, academic journals and more than 3,000 pages from historical newspapers, SURGEDAT initially identified over 200 surges along the U.S. Gulf Coast since 1880. The project has now expanded, incorporating hundreds of sources from all over the world to generate a global dataset and map. The database isn't just a useful tool for researchers. Decision-makers have also seen many benefits from SURGEDAT. Keim and Needham have been in contact with decision-makers along the Gulf Coast including the Houston/Galveston National Weather Service office, the Rice University Houston Ship Channel Project, and the Texas A&M Galveston Ike Dike Project. The latter two of these groups are working on multi-million to multi-billion dollar projects for surge protection, and Keim and Needham are providing valuable climatological perspectives in each of these cases.

NEW RESEARCH IN 2012

- SCIPP worked with three National Weather Service River Forecast Centers in the southern U.S. to learn about how emergency managers, public safety officials, and others use flood information.
- SCIPP researchers conducted more than 500 phone interviews with residents of nine Louisiana parishes to examine the roles of emotion, knowledge and past experience in preparing, evacuating, and relocating as a result of hurricanes. They determined that the single most influential factor when making decisions regarding hurricanes is the intensity, or strength, of the storm.
- Water resource managers have indicated that easily accessible reservoir information is crucial in their drought planning and mitigation efforts. In response, SCIPP is developing both a reservoir data and visualization tool, and compiling a comprehensive database for real-time and historical water reservoir data.

CONNECT

www.southernclimate.org

www.twitter.com/SCIPP_RISA

www.facebook.com/SouthernClimateImpactsPlanningProgram

www.youtube.com/user/SCIPP01

WESTERN WATER ASSESSMENT



Top: WWA's Ben Livneh and Eric Gordon measure canopy albedo in a forest affected by mountain pine beetles as part of a project to understand drivers of unusual snowmelt patterns in the Upper Colorado River Basin. Ben Livneh/WWA **Bottom:** WWA Principal Investigator Brad Udall moderates a panel on drought and the economy at the Colorado Water Conservation Board's 2012 Drought Conference. Eric Gordon/WWA **Background:** Aspens in Rocky Mountain National Park. Brian Kahn/IRI

WWA IN 140 OR LESS...

Developing, integrating, and applying information on climate and society for water resource decision making in the Intermountain West.

2012 HIGHLIGHT

In 2012, WWA researchers Jeff Deems, Noah Molotch, Carol Wessman, Joe Barsugli and Klaus Wolter continued to work with the Colorado Basin River Forecast Center (CBRFC) on a major project aimed at understanding drivers of snow accumulation and melt in the Upper Colorado River Basin with the ultimate goal of improving CBRFC's quantitative streamflow forecasts. Over the past decade, the Upper Colorado River Basin has experienced unusual runoff patterns resulting in anomalously high errors in peak and daily streamflow forecasts. Improving those forecasts can help water managers in the region better manage reservoirs and other water systems. CBRFC and managers both suspected that bark beetle infestations and/or increased dust deposition on snowpack might be causing these runoff anomalies. To address this concern, a multidisciplinary team of WWA researchers with expertise in climatology, meteorology, snow hydrology, and landscape ecology is using a novel combination of methodologies to understand the relative contribution of each of these various snowmelt drivers. To date, the WWA team has used a sophisticated hydrology model to explore the degree to which snow accumulation and melt is affected by beetle kill and dust deposition. Future work will entail integrating these model findings into CBRFC's operational forecasts and testing to see if they result in improved flow predictions.

NEW RESEARCH IN 2012

- To understand what the process of incorporating climate information into water resources management looks like in real time, WWA researchers are observing and evaluating a project aimed at developing tree ring chronologies of streamflow and bringing that information to water managers in Utah's Wasatch Front.
- WWA is partnering with The Nature Conservancy to develop greater capacity for providing climate science guidance for conservation efforts in the Southwest. The project entails creating a training curriculum for future climate scientists capable of meeting such capacity needs and learning how to help move from vulnerability assessment towards adaptation in conservation.

CONNECT

wwa.colorado.edu

wwa.colorado.edu/events/webinars

CHAPTER 2:

Extreme Events & RISA Research and Response



Left: Satellite image of Hurricane Sandy as it bears down on the East Coast. NOAA Environmental Visualization Laboratory **Middle:** Arctic sea ice. NOAA Coastal Service Center **Right:** Dr. Melissa Finucane on the set for production of the “Climate Matters for Waikiki Beach” Document. Victoria Keener/Pacific RISA



Damage from Sandy on Staten Island. CCRUN researchers are working with partners at federal, state and city agencies to survey damage and incorporate lessons learned during planning, response and clean up into future disaster planning in the New York metropolitan area. Somayya Ali/NASA GISS

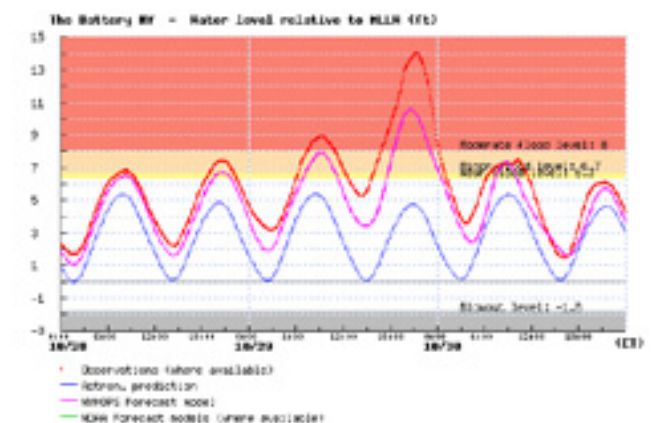
In 2011, 14 different billion-dollar weather and climate-related disasters affected the U.S., the most ever to impact the country. The U.S. fared only slightly better in 2012, with 11 billion-dollar disasters, the second most ever to hit the country. The most costly in 2012, Hurricane Sandy, captured the public and elected officials’ attention. Sandy not only increased interest in what drives extreme events but also increased focus on how to make society more resilient to them.

While the broad public focus on extreme events might be relatively new, researchers throughout the RISA community have been looking at the causes, effects, and steps needed to adapt to extreme events for some time. Researchers have explored what singular, fast-moving events like Sandy as well as what longer developing and lasting events mean for the communities and stakeholders they work with. At the same time, they’ve also looked to understand how those communities perceive and adapt to extremes.

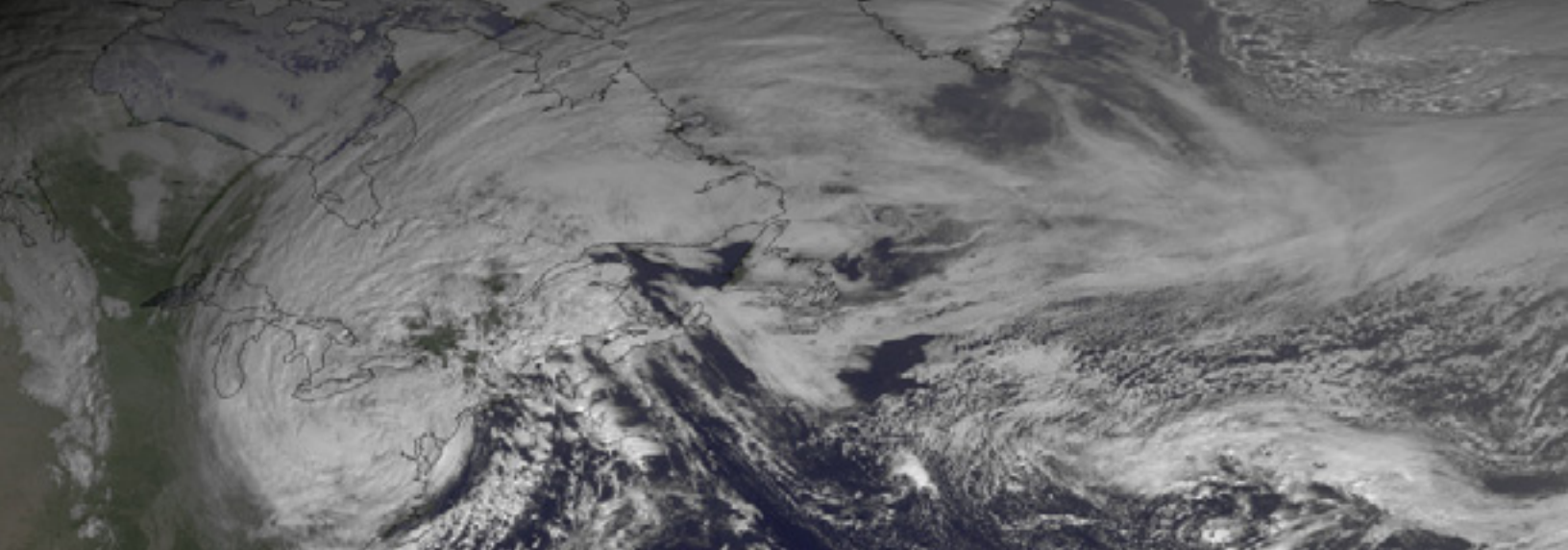
A COASTAL WARNING

By almost any measure, Sandy was extreme. Tropical storm-force winds stretched over 520 miles from its center. When it made landfall, the storm surge rose 13.88 feet in Lower Manhattan, easily surpassing the old record of 10.02 feet. Further inland, Sandy dumped over a foot of snow across six states. In its wake the storm left seven of New York’s subway tunnels flooded, thousands of homes destroyed, and 8.1 million people without power up and down the Eastern Seaboard.

Leading up to landfall, CCRUN researchers utilized their **New York Harbor Observing and Prediction System (NYHOPS)** to predict surface currents and water elevations around New York City and the New Jersey coastline. NYHOPS served as a key resource for groups including U.S. Coast Guard, various divisions of NOAA, New York State and New York City Office of Emergency Management, New York City Department of Environmental Protection, Long Beach Island, NJ, the City of Hoboken, and utility provider Con Edison in planning for and reacting to the storm as it bore down on the New York metropolitan area.



A plot from NYHOPS showing the storm surge before, during and after Sandy at the Battery tide gauge in Lower Manhattan. The plot also shows the astronomical tides and the NYHOPS forecast model. as well as near, minor and moderate flood levels.



A satellite image of Sandy as it moves over the Eastern Seaboard. Tropical storm-force winds stretched over 520 miles from its center as did rain and snow. NOAA

In the aftermath of the storm, CCRUN researchers are working with the NOAA Coastal Services Center to provide updated sea level rise scenarios as guidance for future planning in conjunction with Federal Emergency Management Administration’s updated Advisory Base Flood Elevations. The scenarios will also be accessible to the public through the [NOAA Digital Coast tool](#).

In addition to maintaining observation networks and creating scenarios, CCRUN is also working extensively with stakeholders to understand vulnerability to extreme flooding events better.

“We’re going to be looking at the impacts of Hurricane Sandy very carefully,” **CCRUN Principal Investigator Cynthia Rosenzweig** said in an interview with climate.gov. “Many of the impacts that occurred have been included in previous studies, but we’re certainly going to go back and evaluate them so we can better inform planning around [future] extreme weather and climate events.”

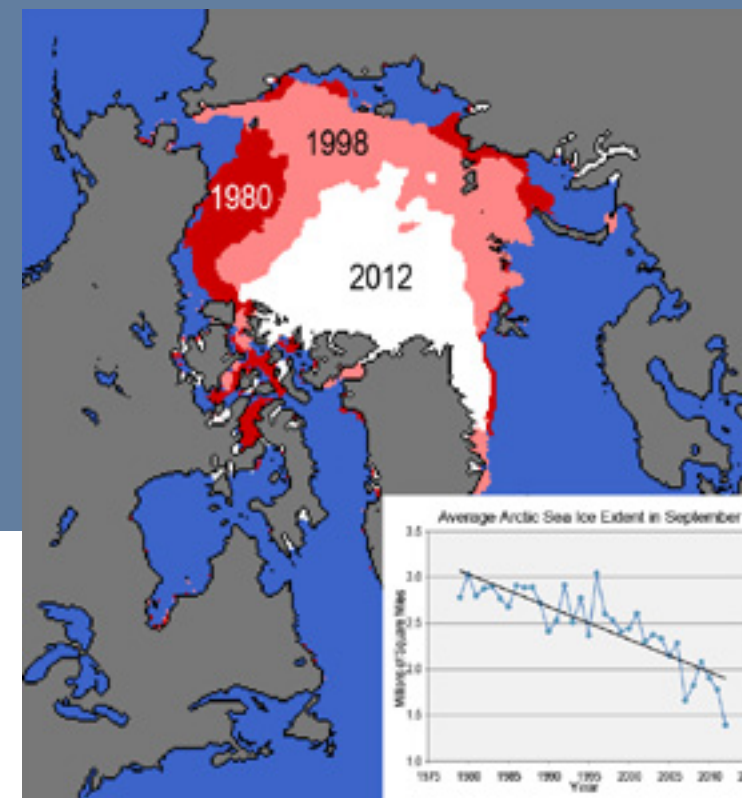
While Sandy has been one of the main frames of extreme events this year, it’s not the only storm RISA researchers have focused on. Scenario planning is also a key component of work being done 3000 miles away by researchers at CNAP.

Torrential rain falling nearly continuously for 45 days might sound absurd, but that’s what happened in California starting on Christmas Eve 1861 and continuing through February 1862. The series of storms turned Sacramento into Venice, created a 3 million acre lake where there was none, and drove the state into bankruptcy by wiping out a third of taxable land including valuable agricultural tracts in the Central Valley.

The incessant rains were likely brought to the state by atmospheric rivers, which draw moisture from the warm equatorial Pacific and then unleash it when they hit the West Coast. Seeing the return of such a storm isn’t outside the realm of possibility as atmospheric rivers regularly bring smaller-scale but still damaging events to the region. In December 2012, **NOAA announced** that it was working in partnership with CNAP researchers and the California Department of Natural Resources to improve monitoring and forecasting of these rainy rapids.

In addition, a consortium of partners including CNAP researchers has created the **ARkStorm scenario** to help decision makers plan for an extreme rain event. Estimates from the scenario indicate that a storm similar to 1861-2 could cause upwards of \$725 billion in damage, dwarfing the largest economic loss ever caused by an extreme event in the U.S. In an effort to reduce possible losses, CNAP researchers are working with federal, state, and local governments to use the scenario to do planning before an ARkStorm hits.

In the Pacific Northwest, CIRC researchers are looking at another key danger posed by coastal storms. Research to-date has focused primarily on documenting the effects of wave height increases or sea level rise alone. However, the coincidence of these two phenomena can exacerbate inundation and erosion along vulnerable



Sea ice extent has declined greatly since 1979, when accurate satellite records started. The inset graph to the left shows the minimum sea ice extent recorded each summer over that period, while the map shows a comparison of three specific years. Sea ice one of the key indicators of the changes taking place in the Arctic. NSIDC

coastlines. This was on display in New York and New Jersey during Sandy: the region has seen seas rise roughly a foot over the last century due mostly to anthropogenic climate change, which exacerbated an already powerful storm surge.

By incorporating sea level rise projections in models, CIRC researchers are working on predicting how it will interact with wave height and beach morphology and affect storm hazards for coastal communities. This modeling effort will aid in structure design, hazard planning, and preparedness for inundation events for coastal communities in the Pacific Northwest.

DROUGHT: SLOW TO EVOLVE, SLOW TO FADE

Sandy took six days to race up the East Coast from the Caribbean and make landfall in New Jersey. Even before making landfall, high winds, rain and snow impacted a large swath of the eastern seaboard.

In comparison, drought onset is generally slow, taking months to multiple seasons to set up. Even the “flash drought” that affected over three quarters of the U.S. this summer developed over a period of weeks rather than days.

RECORD SEA ICE MINIMUM

The 2012 summer Arctic sea ice extent was the lowest ever recorded with a clear downward trend over the past three decades. Loss of sea ice has wide ranging effects. NOAA Administrator **Jane Lubchenco** noted in an interview with climate.gov, “Changes that are underway in the Arctic affect weather patterns elsewhere.” Decreasing sea ice extent offers opportunities for trans-Arctic shipping and increasing oil and gas development. There are also important military considerations and implications for expanding coast guard coverage and Arctic oil spill response.

The rapid decrease in ice, particularly multi-year ice, is changing ecosystems and altering communities’ ways of life in one of the most fragile parts of the world. To help convey the latest research on changing sea ice, permafrost and glaciers, ACCAP launched a new newsletter, **Changing Ice**, in December 2012 in collaboration with the DOI Alaska Climate Science Center and the Alaska State Division of Geological and Geophysical Surveys.

In addition, ACCAP is producing a Digital Sea Ice Atlas in partnership with the Alaska Ocean Observing System, National Weather Service Anchorage Office Sea Ice Desk, National Snow and Ice Data Center and Pacific Environmental Marine Laboratory. The Atlas will consist of digitally-stored sea ice concentration data on a grid covering all Alaska coastal waters to a distance of roughly 300 miles from shore, with a 15.5 mile spatial resolution.



Drought also tends to be a much more lasting phenomenon. The Southern Plains is now in its third consecutive year of drought, dating back to October 2010. Ongoing drought conditions have resulted in a disastrous winter wheat crop in 2010-11, reduced forage causing ranchers to sell off parts of their herds, and dropped lake levels to near-record lows leaving boats stranded and curtailing irrigation releases critical to the Texas rice crop, which accounts for 7% of the nation’s rice supply.

The persistent drought conditions in the Southern Plains led SCIPP researchers to start a monthly Managing Drought webinar series in September 2011. As drought conditions across the region have continued, so have the webinars with updates from experts on the state of the drought. In addition, researchers have shared their knowledge with stakeholders about different tools and resources for planning around drought and its impacts. The webinars are archived on the [SCIPP website](#) and represent a rich resource.

Researchers at SECC have also provided vital information to stakeholders in the Apalachicola-Chattahoochee-Flint River Basin, which has been drought-stricken since 2011. Partnering with the National Integrated Drought Information System, SECC researchers have been using webinars and newsletters to provide regular climate and water forecast updates. Regular attendees include water managers, representatives state resource organizations and local non-governmental organizations, journalists, and the general public.

CISA has also partnered with NIDIS to develop drought early warning projects in the coastal region of the Carolinas where drought effects on coastal and environmental resources are not as well-understood or as well-integrated into existing drought planning and response.

To date, CISA researchers have written a state of the knowledge report to identify drought impacts on coastal ecosystems and organized a scoping workshop to lay the groundwork for drought early warning pilot projects. Workshop participants selected four pilot projects and steering committees began work in Fall 2012 to plan those pilot activities. The projects will evaluate drought indicators and indices for coastal ecosystems, engage with the CoCoRaHS network to improve drought impact reporting, address needs



Trash on the newly-revealed shore of Lake Thunderbird, which provides drinking water for Norman, Oklahoma. Due to the ongoing drought, the lake was at 71 percent capacity in September 2012 when the photo was taken. Brian Kahn/IRI



A freshwater swamp in Cypress Bay, North Carolina during the 2008 drought. William Conner/CISA

TOO HOT, TOO COLD

Unprecedented warm temperatures in Spring 2012 in the Great Lakes region caused fruit trees to blossom early. However, the warm weather was followed by hard frosts that destroyed a substantial portion of the 2012 fruit crop. GLISA spent much of the summer and fall communicating with fruit growers and the public about what caused the curious start to the growing season. GLISA is now funding and collaborating on a project led by the Northwest Michigan Horticultural Research Center to engage tart cherry producers in the northern part of Michigan’s Lower Peninsula, who have experienced near total crop losses twice in the past decade due to blooming of trees before the final frost.

for drought forecasting tools, and assess and communicate public health concerns related to drought and seafood consumption.

UNDERSTANDING WHAT OTHERS UNDERSTAND

How do stakeholders understand and react to extreme events? Understanding the answers to that question can help each RISA better provide the services their stakeholders need most.

CLIMAS researchers are currently carrying out a mixed methods social science project aimed at understanding the climate and weather extremes that most concern stakeholders in Arizona and New Mexico. They conducted a survey over the summer to gather preliminary data from stakeholders across multiple sectors in the Southwest, including agriculture, water management, urban planning, and energy production. The second phase of the project will involve in-depth interviews with a subset

of stakeholders to further explore key concerns and is set to be carried out in Spring 2013. The completed project will contribute to the literature on perceptions of extreme climate events and help CLIMAS set its research agenda over the next few years.

In Colorado, Utah and Wyoming, WWA researchers are in the midst of a multi-year effort to systematically investigate the conditions under which decision makers in cities and large towns decide to adapt (or not) to climate-related risk and hazards, such as blizzards, tornadoes, and floods.

Early findings indicate that while there is generally wide exposure to various types of hazards, the perception of risk varies greatly as does the type and degree of responses initiated as a result of exposure to hazards. Thus it appears that while events can spur adaptation, there is often another explanation for a municipality undertaking adaptive action, such as the presence of a champion for the effort, the availability of additional financial resources, or opportunities for collaboration at other levels of government. To refine these findings, WWA researchers will carry out three in-depth case studies of different municipalities in 2013.

The Pacific RISA has looked to not just understand how people are adapting to extremes but to also show successful efforts. Researchers have produced “[Documoments](#),” a video series that portrays personal narratives about why

climate and climate information is important for various sectors in Hawaii. In one case, PVT Land Company improved its storm water system after NOAA's announcement that Winter 2010 would likely be wetter than normal due to La Niña. Those were the right measures to take. The landfill and other parts of Hawaii received record-breaking rainfall during a storm in December 2010. PVT was able to quickly divert high waters and save millions of dollars as a result even as other landfills closed or experienced damages. By sharing this story of resilience in the face of extreme events, Pacific RISA researchers hope others will consider measures they can take in Hawaii and beyond.



Flood damage in Kihei, Maui after heavy rainfall due to a La Niña event. PVT Land Company was able to reduce damages like this and save millions of dollars using seasonal climate forecasts ahead of that winter's storms. Victoria Keener/Pacific RISA

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